NON-PUBLIC?: N
ACCESSION #: 8905010104
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Rancho Seco Nuclear Generating Station PAGE: 1 of 5

DOCKET NUMBER: 05000312

TITLE: Automatic Shutdown of Reactor Due to Low Main Feedwater Flow
EVENT DATE: 03/28/89 LER #: 89-004-00 REPORT DATE: 04/27/89

OTHER FACILITIES INVOLVED: NAME: DOCKET NO: 05000312,
05000312

OPERATING MODE: N POWER LEVEL: 084

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Steve Rutter, Supervisor, Independent TELEPHONE: 916-452-3211
Investigation/Reviews

COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE TO NPRDS:

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On March 28, 1989, at 1516 hours, while operating at 93% power, the plant's Main Feedwater Pumps (MFPs) experienced speed control problems. This resulted in a rapid loss of feedwater flow to the steam generators. The corresponding increase in Reactor Coolant System (RCS) pressure caused the plant to automatically shut down.

Because of the MFP controller problems, the Integrated Control System (ICS) response to the pre-trip underfeed caused the post-trip feedwater refeed to the RCS to be greater than expected. This resulted in a pressurizer level drop to the elevation of the level indicator tap.

The plant did not exit the post-trip window, and normal post-trip levels were established 14 minutes after the trip.

END OF ABSTRACT

Description

On March 28, 1989, Rancho Seco was operating at 93% power with the Integrated Control System (ICS) in full automatic. At 1210 hours and 1320 hours, Operators received a "125 V DC BUS E TROUBLE" alarm. Technicians were dispatched to investigate the cause of the alarm, but the alarms had cleared before the cause could be determined.

At 1308 hours and 1417 hours, the plant experienced minor Main Feedwater (MFW) oscillations. The ICS compensated for these speed fluctuations by changing Main Feedwater Pump (MFP) demand signal, thus having little effect on plant operation. The Shift Supervisor responded to these MFW oscillations by notifying System Engineering who initiated an investigation into the cause of the MFW anomalies.

At 1516 hours, with the MFW investigation still in progress, the speed of both MFPs suddenly decreased. The 'A' MFP decreased approximately four times faster than the 'B' MFP. After partial recovery of both pumps, MFW flow in both loops again decreased, causing increase in Reactor Coolant System (RCS) temperature and pressure and reactor power runback due to reactor cross limit. Licensed Control Room Operators responded to the RCS pressure increase by placing the pressurizer spray valve and heaters in manual, opening the valve, and spraying the pressurizer.

Despite Operator attempts to stabilize RCS pressure, it continued to rise until reaching the high pressure trip setpoint of 2355 psig. The RCS high pressure trip occurred at 84% power.

Following the trip, pressurizer level started decreasing. Post-trip pressurizer level dropped more rapidly than normal due to an excess feedwater refeed. The 'B' MFW flow increased to 80% of its pre-trip value. The 'A' MFW flow increased to slightly over 100% of its pre-trip value. The excess refeed lasted approximately 30 seconds before returning to normal post-trip refeed values.

Licensed Control Room Operators responded to the pressurizer level decrease by starting the High Pressure Injection (HPI) 'A' and 'B' pumps and opening the HPI 'A' valve. This was done in accordance with Emergency Procedure E.02, "Vital System Status Verification." Prior to level restoration, pressurizer level dropped to 0 inches as indicated on the pressurizer level strip chart recorder. (Because of the elevation of the level tap on the pressurizer, there is still 240 cubic feet of coolant inventory in the pressurizer when the

strip chart recorder reaches 0 inches.)

While the pressurizer level and RCS pressure were recovering, licensed Control Room Operators throttled HPI makeup. RCS pressure started to decrease. At this time licensed Control Room Operators realized that the pressurizer heaters and pressurizer spray valve were in manual and the valve was open. The valve and heaters were returned to automatic and the valve was closed.

The plant did not exit the post-trip window, and normal post-trip levels were established 14 minutes after the trip.

Approximately one half hour after the reactor trip, main condenser vacuum began to degrade from its pre-trip level of 27 inches of mercury. Licensed Control Room Operators entered Casualty Procedure OP-C.26, "Loss of Condenser Vacuum." In accordance with OP-C.26, licensed Control Room Operators placed Main Air Ejector Y-342B into service. This did not terminate the vacuum degradation. Licensed Control Room Operators then placed a hogging air ejector into service and dispatched Operations personnel to investigate possible sources of vacuum leaks. Operators adjusted the covers on the Moisture Separator Reheater (MSR) relief valves and adjusted MSR sealing steam. Following these actions, licensed Control Room Operators were able to maintain normal condenser vacuum without the hogging air ejector. Prior to recovery, the vacuum reached a low point of 20 inches of mercury.

Reactor trip on high RCS pressure is an automatic actuation of the Reactor Protection System (RPS) and is reportable pursuant to 10 CFR 50.73(a)(2)(iv).

Cause of the Event

The cause of the reactor trip was high RCS pressure due to reduction in MFW flow.

The root cause of the MFW fluctuations is undetermined. Because both MFPs reacted similarly during this event, the investigation into the cause of the trip focused on elements that are common to both pumps. The major portions of this investigation were: possible personnel activities affecting the MFPs, ICS, Radio Frequency Interference (RFI), and pumps' control power supply. A summary of the results of each investigation is listed below:

Personnel Activities - A review of the plant firewatches indicated that none were present at the MFW pumps or associated control equipment at the time of the transient. A review of scheduled maintenance work was conducted. This review did not uncover any maintenance activities that could have affected

the pumps.

Integrated Control System - Because the ICS is the common source of speed control to the MFP controllers, it was analyzed to determine if it could have caused the MFW transient. The analysis compared decrease in pump speeds with MFP responses to a manual pump trip test conducted at 85% power on August 5, 1988. The analysis also studied ICS demand signals during two previous transients. The analysis concluded that disturbances to the MFP controllers caused this transient and that the disturbance most likely came from interruption in the control power supply to the pumps.

Electromagnetic or Radio Frequency Interference - This investigation examined possible signals induced into the pump controllers from Electromagnetic Interference (EMI) or Radio Frequency (RF) noise. This was considered a possible scenario because strip chart recorders were connected to both controllers and the leads for these recorders were not shielded. A special test (STP.1234, Radio Interference in the Vicinity of Main Feedwater Pump Controllers) was conducted to investigate this possibility. The results of this test concluded that RF noise did not affect the pump controllers.

Pumps' Control Power Supply - Both MFPs had control power from the same bus (125 Volt DC Bus SOE). Alarms had occurred earlier in the day on the bus, but were not coincident with the MFW perturbations. This short could have caused the inverters that supply the MFP controllers to trip and restart. An initially restarted inverted has large output voltage swings for several seconds, thus causing erratic performance of the pump controllers. The most likely root cause for the MFW transient was a fault on the 125 V DC SOE bus.

The cause of the degraded post-trip vacuum was out of position MSR valve covers in conjunction with other vacuum leaks.

Energy Industry Identification System Component Function Identifier and System Name

The system identifier for the Main Feedwater System is SJ. The component identifier for the MFPs is P. The component identifier for the pump speed controllers is SC. The component identifier for the pump control power supply inverted is INVT.

Manufacturer and Model Number of Affected Components

The MFPs are manufactured by Westinghouse Electric Corporation. The model number is EMM-32AN. The pump controllers are manufactured by Lovejoy Controls. The model numbers are BFTA & BFTB. The pump control power supply

inverters are manufactured by Topaz Electronics. The model number is 500-GE-125-60-115.

Assessment of the Safety Consequences

The RPS operated as designed. The reactor tripped on high RCS pressure at th

proper setpoint (2355 psig). Adequate RCS subcooling margin was preserved at all times following the event. The plant never exited the post-trip window.

The health and the safety of the public were not affected as a result of this event.

Corrective Actions

Since the cause of the disturbances leading to erratic MFP behavior could not be positively determined, a test program was established to monitor pump operation from startup through full power operation. This test program is Engineering System Action Plan No. 32, "Investigation of Main Feedwater Control Spikes."

To preclude the possibility of a single failure of the 125 V DC SOE bus causing problems to both MFPs, the 'B' MFP has been transferred to the 125 V DC SOF bus. Design Change Package (DCP) R89-0051 was performed to implement this change.

TEXT PAGE 5 OF 5

The corrective action for the out of position MSR covers is to improve MSR seal steam such that valve covers are not required. This will reduce operator burden for having to place covers post trip and reduce potential vacuum leaks. DCP R88-0081 will implement this improvement. The DCP will be completed prior to the end of Cycle 8 refueling outage.

The corrective action for not restoring the pressurizer spray valve and heaters to automatic was issuance of a lessons learned memorandum to advise Control Room Operators on the importance of monitoring equipment that has been placed in manual and restoring pressurizer heaters to automatic after an out surge of reactor coolant.

A review of previously submitted LERs indicated reactor trips due to MFW perturbations described in LERs 88-018, 85-025, 85-023, 84-07, 79-01 and 78-01.

ATTACHMENT 1 TO 8905010104 PAGE 1 OF 1

SMUD

SACRAMENTO MUNICIPAL UTILITY DISTRICT 6201 S. Street, P.O. Box 158300, Sacramento CA 95852-1830, (916) 452-3211

AN ELECTRIC SYSTEM SERVING THE HEART OF CALIFORNIA

CEO 89-192

April 27, 1989

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Docket No. 50-312
Rancho Seco Nuclear Generating Station
License No. DPR-54
LICENSEE EVENT REPORT 89-04: AUTOMATIC SHUTDOWN OF REACTOR DUE TO LOW MAIN
FEEDWATER FLOW

Attention: George Knighton

In accordance with the requirements of 10 CFR Part 50.73(a)(2)(IV), the Sacramento Municipal utility District hereby submits Licensee Event Report Number 89-04.

Members of your staff with questions requiring additional information of clarification may contact Mr. Steve Rutter at (209) 333-2935, extension 4911.

Sincerely,

Joseph F. Firlit
Cheif Excutive Officer
Nuclear

Attachment

cc w/atch: J. B. Martin, NRC, Walnut Creek
A. D'Angelo, NRC, Rancho Seco
INPO

*** END OF DOCUMENT ***